EGRESS FACILITIES SERVING THE WTC CONCOURSE
A RE-ANALYSIS, CONSIDERING CURRENT OCCUPANCY

ENGINEERING DEPARTMENT

December 1979

Varouch: This draft has not been approved by DOM. Jimiz 9/30/81

I. History

1) General

In June of 1975, the firm of Emery Roth & Sons, the responsible Architect of the World Trade Center, submitted an analysis, entitled "WTC Concourse Level Egress". The analysis, in the form of a letter, E. Roth & Sons to M.P. Levy, dated June 11, 1975, outlines, in detail, the nature of the various occupancies then in existence or being planned as well as the locations, types and capacities of all egress facilities then existing or being planned in accordance with the requirements of the New York City Administrative Building Code. The key element in the configuration of this floor level is the treatment of the entire Concourse as an exit passageway as defined in the Building Code. However, construction does not fully comply with all Code requirements, as shown under 2.), below. The analysis concludes that available egress facilities exceed total occupancy, but stresses the importance of clear exit graphies, supported by the installation of a public address system.

2) Construction Features of the Concourse

A) Code Requirements

Each of the Tenant Spaces on the Concourse is separated from adjacent Tenant Spaces by 2 hr. fire rated masonry partitions, slab to slab. Each space is fully sprinklered, with an additional sprinkler curtain system at the side facing the public passageway. All HVAC duct penetrations are fire-dampered and all other penetrations fire-stopped. N.Y.C. Code Section 604.3 (h) (3) 3. requires certain other construction provisions of the exit passageway and the adjacent spaces which are not fully complied with.

Following is a listing of all requirements of the above Code section; which stipulates that:

> "Show windows or other openings of unlimited lengths and heights shall be permitted on any corridor or exit passageway without requirements for fire-resistance doors under the following conditions:
>
> (a) The entire floor area, including the corridors or

exit passageways, shall be provided with automatic sprinklers complying with the construction requirements of article 17.

(b) The occupancy of all spaces on the floor shall be limited to occupancy groups C, E, F-3 and F-4.

(c) The widths of the corridors or passageways shall exceed the requirements of table 6-1 or sub-division (b) of this section, whichever is applicable, by at least 50 per cent.

(d) All doors opening on the corridors or exit passageways shall be smokeproof, noncombustible, self-closing doors.

(e) Show windows or other openings shall be glazed by ¼ in. polished plate glass or equivalent.

(f) Each corridor or exit passageway shall be provided with a fresh air intake, a positive smoke exhaust system and smoke detectors which, when activated, shall permit circulation only of fresh air.

Of the above requirements, (a) and (d) are not fully complied with, to the extent that Sprinklers have not been provided in the public passageways, and that most of the doors, opening onto the passageways are not self-closing. "

B) Other Construction Features Provided

Smoke detectors and/or rate of rise detectors inside the tenant space (at the Storefront Bldg.) shut down the HVAC system on activation. A breakglass push button identified as "Smoke Purge System" located near the store front, restarts the exhaust fan, closes return air dampers, opens the spill air damper, keeps the supply fan off and closes tempered air and toilet exhaust motorized dampers. Provisions are made to convert the present manual breakglass operation to a remotely operated system (from the Fire Command Station).

The above system of Smoke-Purge-only operation in the tenant space during a fire emergency, when combined with the simultaneous outside air supply only operation in the public passageway can be expected to minimize the migration of smoke into the corridors.

The Lobbies of Towers "A" and "B", including their Mezzaninies are constructed and used such as to also qualify as Exit Passageways, except that Sprinklers have not been provided. Since they are separated from the Concourse Public Passageways only by glass doors, which have no fire rating (except that they may serve as smoke stops), the Tower Lobbies are viewed for the

purpose of this egress analysis as extensions of the Concourse exit passageways.

II. Comments on E.R. & S. Analysis

Exit capacity has been provided such as to permit a)simultaneous evacuation of all occupants from all spaces of the Concourse. Furthermore, the analysis assumes that the legal people capacity of twelve stairs, which terminate at the concourse and which provide means of egress from below-grade areas is to be added to the required capacity of the exits serving the concourse. As to item a), because of the contiguous configuration of the public passageways of the concourse, which represents a continuous, non-separated network, (leading to exits) on which border all occupancies, there is some justification for viewing the sum total of all occupancies whose path of egress lead through the public passageway as one common occupancy, which together, determine the required egress capacity from the Concourse. However, for several reasons, including the fact of fire-rated physical separation of all tenancies from each other, as described in greater detail below, and the significant distances between various groups of occupancies from each other, the probability of a need for simultaneous evacuation of all concourse areas in response to an emergency situation must be considered remote. Furthermore, the probability of maximum theoretical occupancy occurring simultaneously in all areas of the concourse must, likewise, be considered low. This is recognized by Emery Roth & Sons who state in their June 1975 letter:

> "Assuming that the maximum conditions would prevail, that is, that the subways and PATH trains would discharge a maximum number of persons, (a condition which will occur at most only during the height of the morning rush-hour), and that all stores, restaurants and banks will be occupied to the limit of their capacity, (a condition that will hardly ever occur simultaneously with the rush-hour), the Concourse might be occupied by a total of 9,205 persons." Nevertheless, E.R. & S. has decided to provide exits sized for a simultaneous evacuation of the entire Concourse. We agree with this apparently conservative approach because of certain considerations not discussed (except for the observation deck) in the above referenced E.R. & S. letter:

There is a considerable transient popluation of the Concourse which is not reflected in the Concourse count, including:

a) Persons,who use the WTC Concourse as a "short-cut" on their way to work at destinations in other than WTC structures.

b) Tourists, including Patrons of the Observation Deck and the Restaurants, including the Tower Restaurants.

c) Business people, traveling to and from the WTC Towers and Plaza Buildings, throughout the business day.

d) Occupants of the WTC Buildings on their way to and from work. This constitutes a very high density "continuous" occupancy of the concourse public passageways for the duration of the morning and evening rush hours. Furthermore, this occupancy coincides with a high degree of occupancy of Stores and Restaurants, especially during the evening rush hours.

Below Grade Areas

As to item b), above, the following observations are made: The below-grade areas are separated from the Concourse and from each other by a minimum of 2 hr. rated construction, all areas are fully sprinklered. Except for the areas immediately below the Towers, which have office occupancies and for which egressing into the above grade Tower lobbies is provided, the below-grade areas have low-density occupancies, generally parking and/or storage. Alternate egress to the street, via the Barclay Street ramp as well as several stairs leading directly to the street is provided. Consequently, we felt that the below-grade areas can be used as Holding areas during fire emergencies on the Concourse and only one half of their actual occupant load has been added to the total occupant count of the concourse, in our tabulation of present concourse occupancy.

Subways and PATH

The E.R. & S. analysis assumes that five subway exits will discharge 300 persons each into the Concourse Passageway and that a maximum of 960 people via eight escalators will enter the concourse from PATH during the morning peak hour. This includes a subway exit which is not yet built near the proposed Alexander's Store, but does not include the IND (local) terminal at the North-East corner of the concourse, since this facility has sufficient alternate exits directly to the street. We agree with the above assumptions regarding ingress into the concourse from subways and PATH.

III. Re-analysis of Concourse Egressing

Since the preparation of the E.R. & S. analysis, certain physical changes have been made or are being planned, which alter the total capacity of exits, serving the Concourse, as described below:

1) Alexander's Department Store

The space bordering on Liberty Street and bounded on the West by Tower B, on the north side by the East-West passage corridor, and on the East side by the North-South passageway was previously planned to contain a Restaurant and "International Plaza" a group

of small"boutique"-like stores. This area will instead house Alexander's Department Store, which has sufficient exit capability directly to Liberty Street. Because maximum allowable travel distances would be exceeded, no other tenancies may exit through this space. This re-analysis consequently excludes the Alexander's Store from the Concourse level occupancy load and exit facility count. However, considering the currently planned final configuration of the Concourse, both exits "C" and "K" (see attachment) are required means of egress from the Concourse only and access to these exits must be configured accordingly.

2) WTC Hotel & Movie Theater

As currently proposed by S.O.M., the Architect for the Hotel, and as accepted by the World Trade Department, the previously planned exit from the concourse through the Hotel to West Street will not be used. Total available egress capacity from the concourse is reduced accordingly. Furthermore, alternate egress from the Hotel into the Tower A Lobby has been proposed by S.O.M., and agreed to by the World Trade Department. A total of 480 persons will have to egress into the Tower during an emergency in the Hotel. In addition, the proposed Twin Towers Theaters (2) which would replace the existing WTC Information Center would require that an additional 460 persons require exiting into the Tower"A" Lobby.

IV. Requirements and Recommendations

1) Additional Exits Required

Calculations made as part of this analysis show a total Concourse population for which egress must be provided of 8,180 persons. Corresponding exit capacity is 6,900 persons, which is inadequate. The number of persons for whom additional exits must be provided is 1,280 (8180-6900). It is recommended that this requirement be met by the installation of a total of four pairs of 36" wide swinging doors with appropriate hardware to be located at the West Street side of Tower "A", and the Liberty Street side of Tower "B". This would provide twelve exit units at 100 persons per unit for a total capacity of 1,200 persons, which closely approximates the current debit.

2) Remote Operation of Smoke Purge System

N.Y.C. Building Code requirements for Sprinklers in the Public Passageways and for smokeproof, non-combustible, self-closing doors bordering the Passageways have not been met (C26-604.3 (h) (3) d). It is our judgement that certain additional measures provided, notably the installation of a smoke purge system in each tenancy - the code requires such a system for the Corridors only - can be expected to minimize smoke migration into the Corridors. However, it is recommended, that the conversion of this smoke purge system to remote operation as outlined in the Tenant Design Guide be accomplished as soon as possible.

V. Conclusions

On the basis of the above Analysis and given the prompt implementation of the requirements for additional construction as outlined above, it is our judgement that the egress facilities of the WTC Concourse can safely handle the currently existing (and planned as listed) occupancy. Our judgement further reflects the following consideration:

1) Width, length and overall configuration of the Concourse public passageways are such as to promote patron safety during a fire emergency. Groups of occupancies are separated from each other by significant distances. At any point of the Concourse patrons can proceed to exits in at least two alternate directions. This ability to "walk away from a fire" while still within the confines of the Concourse property makes a need for total evacuation of the Concourse in the event of a fire within any individual occupancy appear unlikely.

2) All Tenant spaces fronting the public passageways have been provided with a break-glass push button-operated Smoke Purge system. Provisions are made for future conversion of this system to remote operation. Although no judgement is made as to whether or not this system is an acceptable substitute for the omitted Sprinklers in the passageways, the system can nevertheless be judged to effectively minimize smoke migration into the passageway provided the non-self closing doors leading into the Tenant spaces are promptly (manually) closed upon the defection of a fire.

3) The Concourse is kept essentially free of combustibles within the requirements of N.Y.C. Code, Section 604.3 (4). However, continued Code compliance and patron safety require continued policing of the Concourse to prevent the placement of merchandise and other combustibles by tenants outside their stores, especially when this is done - as has occasionally been observed - in a manner which causes interference with the prompt closing of storefront doors.

VI. Appendix

Detailed schedules, listing all Tenant spaces and their occupant loads and schedules, and notes describing all exits and their legal capacity are attached. Also attached is a copy of Drawing A-1, which is a plan of the Concourse marked up to graphically support the above schedules.

A) COUNT OF EXIT FACILITIES

EXIT DESIGNATION	EXIT DESCRIPTION	EXIT CAPACITY: NO. OF UNITS	EXIT CAPACITY: PERSONS PER UNIT	EXIT CAPACITY: TOTAL PERSONS	REMARKS
A	Liberty Street exits from Alexand. Dept. Store	9	100	0	Serves Dept. Store only
B	Exits through Tower "B"			890*	See Note No. 1 (Sheet 6)
C	Exits to Liberty Street (via S.E.P.B. Elevator Lobby)	8	100	800	Capacity set by width of Elevator Lobby (S.E.P.B.)
D	Stairs to Liberty Street exits	20	60	1200*	Capacity set by stairs
E	Stairs and escalator to Church St. Underpass	6½	60	390*	See escalator note
F	To Dey St. Underpass, escalators and stair	10	60	600(1)*	(1)Not fully available until Dey St. side of Underpass is built
G	Exits (stairs) to IND Subway	18	60	1080	See escalator note
H	(2) Escalators to Plaza, (2) Revolv. Doors and (2) Swing Doors to Vesey St.			540*	See Note No. 2 (Sheet 2)
I	Exits through Tower "A"			890*	Same capacity as Tower "A"
J	Escalators (2) and stairs (1) to Church St. via S.E.P.B.	6	60	360*	See escalator note
K	Stairs to S.E.P.B. Lobby near Alexanders	2½	60	150	

TOTAL = 6900 Persons

11 Main Exits = Total available exit capacity from Concourse, assuming simultaneous evacuation.

Escalator Note:
*Provided that one of the two escalators (the one which normally runs downward) is equipped with automatic fire detection system (C-26-604.11 (b.)), which causes it

B) OCCUPANT CALCULATIONS

	OCCUPANT	PERSONS PER/SPACE	SPACE TOTAL	SUB TOTAL	GRAND TOTALS
A	KODAK	184			
	MONEY EXCHANGE	28			
	DRUG STORE	102			
	RESTAURANT	850			
	UNOCCUPIED	46			
	TOBACCONIST	34	1240		
B	RESTAURANT	250			
	NEWSSTAND	8			
	LOCKSMITH	11			
	LIQUOR	107			
	SHANE	88			
	NUNN BUSCH	45	509		
D	KELLY FILM	16			
	PATH CARD & GIFT	34			
	PARK LANE	18			
	FANNY FARMER	18			
	BUTTERFLY	138			
	HOFFRITZ	17			
	BENHIL	107			
	FAO SCHWARTZ	87	435		
E	BAKER SHOES	82			
	LERNERS	220			
	KELLY FILM	38			
	OPTICAL	60		2,184	

	OCCUPANT	PERSONS PER/SPACE	SPACE TOTAL	SUB TOTAL	GRAND TOTALS
	ANDRE KIDDE	107			
	BOOKSTORE	42			
	GIFTSHOP	89			
	FURNITURE SHOP	66			
	REPUBLIC BANK	25	729		
F	MANHATTAN SAVINGS BANK	94			
	UNOCCUPIED	75			
	FANNY FARMER	22	191		
C	EAST RIVER SAVINGS BANK	67			
	CLASSIC BOOKS	45			
	OPTICIAN	49			
	LEMANS	65			
	NEWSSTAND	12	238		
I	NEWSSTAND	12			
	FIRST NATIONAL CITY	112			
	CHASE MANHATTAN	121			
	INNOVATION	85			
	FLORIST	60			
	PLYMOUTH	214			
	SHE CREATIONS	76			
	SWISS BANK	25			
	LAMSTONS	275			
	HALLMARK	123		1,158	

	OCCUPANT	PERSONS PER SPACE	SPACE TOTAL	SUB TOTAL	GRAND TOTALS
	GOOD LIFE	54			
	SHINE RAP	22			
	BARTON	29			
	INDIAN BOUTIQUE	55			
	UNOCCUPIED	55			
	CHATHAM CLEANERS	13			
	CHEM BANK	95			
			1426		
G	(ALEXANDERS)			Exits directly to Liberty Street	
	SIDEWALK CAFE	241	241		
S1	SUBWAYS	300			
S2	SUBWAYS	300			
S3	SUBWAYS	300	1500		
S4	SUBWAYS	300			
S5	SUBWAYS	300		3167	
No. 1	INGRESS STAIR	120			
No. 2	INGRESS STAIR	120			
No. 3	INGRESS STAIR	120			
No. 4	INGRESS STAIR	120			
No.5	INGRESS STAIR	120			
No. 6	INGRESS STAIR	150			
No. 7	INGRESS STAIR	120	Below Grade Stairs, terminating on Concourse		
No. 8	INGRESS STAIR	120			
No. 9	INGRESS STAIR	120			
No. 10	INGRESS STAIR	120			
No. 11	INGRESS STAIR	150			

	OCCUPANT	PERSONS PER/SPACE	SPACE TOTAL	SUB TOTAL	GRAND TOTALS
No. 12	INGRESS STAIR	120			
No. 14	TO TOWER "A" LOBBY	150			
NO. 15	TO TOWER "B" LOBBY	150	250 (3) (Stairs 1 through 12) 14 and 15		
No. 13	INGRESS STAIR FROM ALEXANDERS MEZZANINE	240	0(4)		
P-1	PATH ESCALATORS	960	960		
HOTEL EXIT THROUGH TOWER "A" LOBBY		480	0(5)		
THEATER EXITS THROUGH TOWER "A" LOBBY		460	460	1,670	Sub-Total
	Plus Sub Total from Page 2 of Appendix			2,184	
	Plus Sub Total from Page 3 of Appendix			1,158	
	Plus Sub Total from Pages 4 & 5 of Appendix			3,167	
				8,179	
Total Occupant Load for which Exit Facilities from Concourse must be provided, say				8,180	Persons

NOTE #1 EXIT CALCULATION, THROUGH TOWER "B":

a.) 2 pairs of 36" wide swinging doors (to Liberty St.,)

1½ units ea. leaf = 2x2x1½ = 6 units @ 100 persons = 600 persons

b.) 2 revolving doors, 1 unit each = 2 units @ 100 persons

(to Liberty Street) = 200 persons

c.) 1 escalator to Mezzanine and Plaza (24" step ea.)

1½ units each @ 60 persons = 90 persons

Total Exit Capacity

through Tower B = 890 persons

NOTE #2 EXIT CALCULATION FOR EXIT"H":

a.) To Vesey Street:

2 revolving doors, 1 unit ea. = 2 units @ 100 persons ea. = 200 persons

1 pair of 36" wide swing doors = 1½ units ea. leaf =

2x1½ = 3 units, 100 persons ea. = 300 persons

b.) To Plaza, via Mezzanine:

2 escalators (24" step ea.) 1½ units ea. @ 60 persons/

unit (1½x2x60) = 180 persons

Total Capacity, Exit H = 680 persons

However, capacity for Concourse use is limited by:

c.) Stairs in corridor between Path Square and N.E.P.B. Lobby:

8 units @ 60 persons ea. 480 persons

d.) Population North of the above Corridor:

Unassigned = 42

Newsstand = 8

Locksmith = 11
= 61* + 61
541 persons, Say 540

*This population has been included in the total Concourse occupancy for which egress is provided.

NOTE #3

Capacity shown for below-grade Stairs Nos. 1 through 12, 14 and 15. Occupant count used here is based on approximate actual occupancy of the most densly occupied below-grade floor and the following exit reductions:

a.) General parking and storage area — 200 persons

b.) Office, shops and storage areas, within the confines of Tower "A" — 150 "

c.) As above, for Tower "B" — 150 "

Total Occupancy Load — 500 persons

d.) Below-grade areas are (fully sprinklered and) separated from the Concourse by a minimum of two hour rated construction. They have alternate means of egress via several stairs and ramps exiting to the Street. Therefore, the Concourse Public Passageways can serve as an Area of Refuge (C26-603.3) permitting an exit reduction of 50%.

Summary

Total Occupant Load - 500 persons
50% Exit reduction - 250 "

Occupant load, for which exits must be provided = 250 persons

NOTE #4

This stair serves as the means of egress from the proposed Alexanders Department Store Mezzanine. The stair is therefore not included in the Concourse Count. Stair terminates within the Alexanders space. Path of egress is

through the store to Liberty Street exits. Capacity of this stair limits the Mezzanine occupancy to 240 persons, unless additional exits are provided.

NOTE #5

The Hotel is separated from the World Trade Center by at least two hour rated construction. The proposed exit from the Hotel into the WTC Lobby is the Hotel's remote exit. The simultaneous occurrence of an emergency in the Concourse, the proposed Twin Theaters and the Hotel is considered improbable. Therefore, the person count from the above Hotel remote exit has not been included in the Concourse Occupant Count, although the required exit units from the Hotel into the WTC Lobby will be provided.

WTCI-20-P
Preliminary
11/20/79

EGRESS FACILITIES SERVING THE WTC CONCOURSE
A RE-ANALYSIS, CONSIDERING CURRENT OCCUPANCY

I. History

1) General

In June of 1975, the firm of Emery Roth & Sons, the responsible Architect of the World Trade Center, submitted an analysis, entitled "WTC Concourse Level Egress". The analysis, in the form of a letter, E. Roth & Sons to M.P. Levy, dated June 11, 1975, outlines, in detail, the nature of the various occupancies then in existence or being planned as well as the locations, types and capacities of all egress facilities then existing or being planned in accordance with the requirements of the New York City Administrative Building Code. The key element in the configuration of this floor level is the treatment of the entire Concourse as an exit passageway as defined in the Building Code, which complies with all requirements except for the omission of Sprinklers in the public passageways. (see item 1b below). The analysis concludes that available egress facilities exceed total occupancy, but stresses the importance of clear exit graphies, supported by the installation of a public address system.

2) Construction Features of the Concourse

Each of the Tenant Spaces on the Concourse is separated from adjacent Tenant Spaces by 2 hr. fire rated masonry partitions, slab to slab. Each space is fully sprinklered, with an additional sprinkler curtain system at the side facing the public passageway. All HVAC duct penetrations are fire-dampered and all other penetrations fire-stopped. N.Y.C. Code, Section 604.3 (h) d, 3 requires certain construction provisions of the exit passageway and the adjacent spaces, of which the requirement for sprinklering of the corridor itself is not met. To substitute for this omission, each tenant space has been provided with the following additional safety features:

Smoke detectors and/or rate of rise detectors inside the tenant space (at the Storefront Bldg.) shut down the HVAC system on activation. A breakglass push button identified as "Smoke Purge System" located near the store front, restarts the exhaust fan, closes return air dampers, opens the spill air damper, keeps the supply fan off and closes tempered air and toilet exhaust mototized dampers. Provisions are made to convert the present manual breakglass operation to a remotely operated system (from the Fire Command Station).

The above system of Smoke-Purge-only operation in the tenant space during a fire emergency, when combined with the simultaneous outside air supply only operation in the public passageway can be expected to minimize the migration of smoke into the corridors.

The Lobbies of Towers "A" and "B", including their Mezzaninies are constructed and used such as to also qualify as Exit Passageways. Since they are separated from the Concourse Public Passageways only by glass doors, which have no fire rating (except that they may serve as smoke stops), the Tower Lobbies are viewed for the purpose of this egress analysis as extensions of the Concourse exit passageways.

II. Comments on E.R.&S. Analysis

Exit capacity has been provided such as to permit a) simultaneous evacuation of all occupants from all spaces of the Concourse. Furthermore, the analysis assumes, that b) the legal people capacity of twelve stairs, which terminate at the concourse and which provide means of egress from below-grade areas is to be added to the required capacity of the exits, serving the concourse. ,As to item a), because of the contigous configuration of the public passageways of the concourse, which represents a continuous, non-separated network, (leading to exits) on which border all occupancies, there is some justification for viewing the sum total of all occupancies whose path of egress lead through the public passageway as one common occupancy, which together, determine the required egress capacity from the Concourse. However, for several reasons, including the fact of fire-rated physical separation of all tenancies from each other, as described in greater detail below, and the significant distances between various groups of occupancies from each other, the need for simultaneous evacuation of all concourse areas in response to an emergency situation must be considered remote. Furthermore, the probability of maximum theoretical occupancy occurring simultaneously in all areas of the concourse must, likewise, be considered low. This is recognized by Emery Roth & Sons who state in their June 1975 letter:

> "Assuming that the maximum conditions would prevail, that is, that the subways and PATH trains would discharge a maximum number of persons, a) condition which will occur at most only during the height of the morning rush-hour), and that all stores, restaurants and banks will be occupied to the limit of their capacity, (a condition that will hardly ever occur simultaneously with the rush-hour), the Concourse might be occupied by a total of 9,205 persons." Nevertheless, E.R.&S. has decided to provide exits sized for a simultaneous evacuation of the entire Concourse. We agree with this apparently conservative approach because of certain considerations not discussed (except for the observation deck) in above referenced E.R.&S. letter:
>
> There is a considerable transient population of the Concourse which is not reflected in the Concourse count, including:
>
> a) Persons, who use the WTC Concourse as a "short-cut" on their way to work at destinations in other than WTC structures.
>
> b) Tourists, including Patrons of the Observation Deck and the Restaurants, including the Tower Restaurants.
>
> c) Business people, traveling to and from the WTC Towers and Plaza Buildings.

Most of this occupancy occurs on the Concourse during much of the business day, including the rush hours.

Below Grade Areas

As to item b) above, the following observations are made: The below-grade areas are separated from the Concourse and from each other by a minimym of 2 hr. rated construction, all areas are fully sprinklered. Except for the areas immediately below the Towers, which have office occupancies and for which egressing into the above grade Tower lobbies is provided, the below-grade areas have low-density occupancies, generally parking and/or storage. Alternate egress to the street, via the Barclay Street ramp as well as several stairs leading directly to the street is provided. Consequently, we felt that the below-grade areas can be used as Holding areas during fire emergencies on the Concourse and only one half of their actual occupant load has been added to the total occupant count of the concourse.

Subways and PATH

The E.R.&S. analysis assumes that five subway exits will discharge 300 persons each into the Concourse Passageway. This includes an exit which is not yet built near the proposed Alexander's Store, but does not include the IND (local) terminals at the North-East corner of the Concourse, since this facility has sufficient alternate exits directly to the Street. We agree with the above assumptions regarding ingress into the concourse from subways. E.R.&S. further assumes that a maximum of 960 people via eight escalators will enter the Concourse from PATH during the morning peak-period. However, sufficient exit facilities now exist on the PATH mezzanine to provide alternate means of egress into the below-grade parking areas, and from there into several stairs and ramps leading to the Street. These areas can serve as areas of refuge during an emergency on the concourse. Consequently, an exit reduction of 50% applies to the PATH occupancy. Since both the Concourse and the PATH Mezzanine are controlled by P.A. personnel, including police equipped with two-way radios, diversion of passengers to the above alternate exits can be accomplished promptly.

III. Re-analysis of Concourse Egressing

Since the preparation of the E.R.&S. analysis certain physical changes have been made or are being planned, which alter the total capacity of exits, serving the Concourse, as described below:

1) Alexander's Department Store

The space bordering on Liberty Street and bounded on the West by Tower B, on the north side by the East-West passage corridor, and on the East side by the North-South passageway was previously planned to contain a Restaurant and "International Plaza", a group of small "boutique"-like stores. This area will instead house Alexander's Department Store, which has sufficient exit capability directly to Liberty Street. Be-

cause maximum allowable Travel distances would be exceeded, no other tenancies may exit through this space. This re-analysis consequently excludes the Alexander's Store from the Concourse level occupancy load and exit facility count. However, considering the currently planned final configuration of the Concourse, both exits "C" and "K" (see attachment) are required means of egress from the Concourse only and access to these exits must be configured accordingly.

2) WTC Hotel & Movie Theater

As currently proposed by S.O.M., the architect for the Hotel, and as accepted by the World Trade Department, the previously planned exit from the concourse through the Hotel to West Street will not be used. Total available egress capacity from the concourse is reduced accordingly. Furthermore, alternate egress from the Hotel into the Tower A Lobby has been proposed by S.O.M., and agreed to by the World Trade Department. A total of 480 persons will have to egress into the Tower during an emergency in the Hotel. In addition, the proposed Twin Towers Theaters (2) which would replace the existing WTC Information Center would require that an additional 460 persons require exiting into the Tower "A" Lobby.

IV. Conclusions and Recommendations

1) Additional Exits Required

Calculations made as part of this analysis show a total Concourse population for which egress must be provided of 7,700 persons. Corresponding exit capacity is 7,080 persons, which is adequate. The number of persons for whom additional exits must be provided is 620 (7700-7080). It is recommended that this requirement be met by the installation of two pairs of 36" wide swinging doors with appropriate hardware to be located at the West Street Side of Tower "A". This would provide six exit units at 100 persons per unit for a total capacity of 600 persons, which closely approximate the current debit.

2) Smoke Purge System

N.Y.C. Building Code requirements for Sprinklers in the Public Passageways and for smokeproof, non-combustible, self-closing doors bordering the Passageways have not been met (C26-604.3 (h) (3) d). It is our judgement that certain additional measures provided, notably the installation of a smoke purge system in each tenancy - the code requires such a system for the Corridors only - can be expected to minimize smoke migration into the Corridors and represents a satisfactory substitute for the literal code requirements. However, it is recommended, that the conversion of this smoke purge system to remote operation as outlined in the Tenant Design Guide be accomplished as soon as possible.

V. Appendix

Detailed schedules, listing all Tenant Spaces and their occupant loads and schedules, and notes describing all exits and their legal capacity are attached. Also attached is a copy of Drawing A-1, which is a plan of the Concourse marked up to graphically support the above schedules.

A) COUNT OF EXIT FACILITIES

EXIT DESIGNATION	EXIT DESCRIPTION	EXIT CAPACITY: NO. OF UNITS	EXIT CAPACITY: PERSONS PER UNIT	EXIT CAPACITY: TOTAL PERSONS	REMARKS
A	Liberty Street exits from Alexand. Dept. Store	9	100	0	Serves Dept. Store only
B	Exits through Tower "B"			980*	See Note No. (Sheet 2)
C	Exits to Liberty Street (via S.E.P.B. Elevator Lobby)	8	100	800	Capacity set by width of Elevator Lobb (S.E.P.B.)
D	Stairs to Liberty Street exits	20	60	1200	Capacity set by stairs
E	Stairs and escalator to Church St. Underpass	6½	60	390	
F	To Dey St. Underpass, escalators and stair	10	60	600(1)	(1)Not fully available unt Dey St. side Underpass is built
G	Exits (stairs) to IND Subway	18	60	1080	
H	(2) Escalators to Plaza, (2) Revolv. Doors and (2) Swing Doors to Vesey St.			540	See Note No. (Sheet 2)
I	Exits through Tower "A"			980*	Same capacity as Tower "A"
J	Escalators (2) and stairs (1) to Church St. via S.E.P.B.	6	60	360*	See Note No. (Sheet 2)
K	Stairs to S.E.P.B. Lobby near Alexanders	2½	60	150	

TOTAL = 7080 Persons

11 Main Exits = Total available exit capacity from Concourse, assuming simultaneous evacuation.

B) OCCUPANT CALCULATIONS

	OCCUPANT	PERSONS PER/SPACE	SPACE TOTAL	SUB TOTAL	GRAND TOTALS
A	KODAK	184			
	MONEY EXCHANGE	28			
	DRUG STORE	102			
	RESTAURANT	850			
	UNOCCUPIED	46			
	TOBACCONIST	34	1240		
B	RESTAURANT	250			
	NEWSSTAND	8			
	LOCKSMITH	11			
	LIQUOR	107			
	SHANE	88			
	NUNN BUSCH	45	509		
D	KELLY FILM	16			
	PATH CARD & GIFT	34			
	PARK LANE	18			
	FANNY FARMER	18			
	BUTTERFLY	138			
	HOFFRITZ	17			
	BENHIL	107			
	FAO SCHWARTZ	87	435		
E	BAKER SHOES	82			
	LERNERS	220			
	KELLY FILM	38			
	OPTICAL	60		2,184	

	OCCUPANT	PERSONS PER/SPACE	SPACE TOTAL	SUB TOTAL	GRAND TOTALS
	ANDRE KIDDE	107			
	BOOKSTORE	42			
	GIFTSHOP	89			
	FURNITURE SHOP	66			
	REPUBLIC BANK	25	729		
F	MANHATTAN SAVINGS BANK	94			
	UNOCCUPIED	75			
	FANNY FARMER	22	191		
C	EAST RIVER SAVINGS BANK	67			
	CLASSIC BOOKS	45			
	OPTICIAN	49			
	LEMANS	65			
	NEWSSTAND	12	238		
I	NEWSSTAND	12			
	FIRST NATIONAL CITY	112			
	CHASE MANHATTAN	121			
	INNOVATION	85			
	FLORIST	60			
	PLYMOUTH	214			
	SHE CREATIONS	76			
	SWISS BANK	25			
	LAMSTONS	275			
	HALLMARK	123		1,158	

	OCCUPANT	PERSONS PER SPACE	SPACE TOTAL	SUB TOTAL	GRAND TOTALS
	GOOD LIFE	54			
	SHINE RAP	22			
	BARTON	29			
	INDIAN BOUTIQUE	55			
	UNOCCUPIED	55			
	CHATHAM CLEANERS	13			
	CHEM BANK	95			
			1426		
G	(ALEXANDERS)			Exits directly to Liberty Street	
	SIDEWALK CAFE	241	241		
S1	SUBWAYS	300			
S2	SUBWAYS	300			
S3	SUBWAYS	300			
S4	SUBWAYS	300			
S5	SUBWAYS	300			
No. 1	INGRESS STAIR	120			
No. 2	INGRESS STAIR	120			
No. 3	INGRESS STAIR	120			
No. 4	INGRESS STAIR	120			
No.5	INGRESS STAIR	120			
No. 6	INGRESS STAIR	150			
No. 7	INGRESS STAIR	120		Below Grade Stairs, terminating on Concourse	
No. 8	INGRESS STAIR	120			
No. 9	INGRESS STAIR	120			
No. 10	INGRESS STAIR	120			
No. 11	INGRESS STAIR	150			

	OCCUPANT	PERSONS PER/SPACE	SPACE TOTAL	SUB TOTAL	GRAND TOTALS
No. 12	INGRESS STAIR	120			
No. 14	TO TOWER "A" LOBBY	150			
NO. 15	TO TOWER "B" LOBBY	150	250 (3) (Stairs 1 through 12) 14 and 15		
No. 13	INGRESS STAIR FROM ALEXANDERS MEZZANINE	240	0(4)		
P-1	PATH ESCALATORS	960	480		
HOTEL EXIT THROUGH TOWER "A" LOBBY		480	0(5)		
THEATER EXITS THROUGH TOWER "A" LOBBY		460	460	1,190	
	Plus Sub Total from Page 2 of Appendix			2,184	
	Plus Sub Total from Page 3 of Appendix			1,158	
	Plus Sub Total from Page 4 of Appendix			3,167	
				7,699	
Total Occupant Load for which Exit Facilities from Concourse must be provided, say					7,700 Persons

NOTE #1 EXIT CALCULATION, THROUGH TOWER "B":

a.) 2 pairs of 36" wide swinging doors (to Liberty St.,)

1½ units ea. leaf = 2x2x1½ = 6 units @ 100 persons = 600 persons

b.) 2 revolving doors, 1 unit each = 2 units @ 100 persons

(to Liberty Street) = 200 persons

c.) 2 escalators to Mezzanine and Plaza (24" step ea.)

1½ units each = 3 units @ 60 persons each = 180 persons*

*Provided, that one of the two escalators is equipped with auto. fire detection system (C26-604.11, (b)). which causes it to stop. It is not now so equipped.

Due to the height of ceilings adjacent to these escalators, several detectors may be required. Their locations require careful analysis.

Total Exit Capacity*

through Tower B = 980 persons*

NOTE #2 EXIT CALCULATION FOR EXIT"H":

a.) To Vesey Street:

2 revolving doors, 1 unit ea. = 2 units @ 100 persons ea. = 200 persons

1 pair of 36" wide swing doors = 1½ units ea. leaf =

2x1½ = 3 units, 100 persons ea. = 300 persons

b.) To Plaza, via Mezzanine:

2 escalators (24" step ea.) 1½ units ea. @ 60 persons/

unit (1½x2x60) = 180 persons

Total Capacity, Exit H = 680 persons

However, capacity for Concourse use is limited by:

c.) Stairs in corridor between Path Square and N.E.P.B. Lobby:

8 units @ 60 persons ea. 480 persons

d.) Population North of the above Corridor:

Unassigned = 42

Newsstand = 8

Locksmith = 11
= 61* + 61
541 persons, Say 540

*This population has been included in the total Concourse occupancy for which egress is provided.

NOTE #3

Capacity shown for below-grade Stairs Nos. 1 through 12, 14 and 15. Occupant count used here is based on approximate actual occupancy of the most densly occupied below-grade floor and the following exit reductions:

a.)	General parking and storage area	200 persons
b.)	Office, shops and storage areas, within the confines of Tower "A"	150 "
c.)	As above, for Tower "B"	150 "
	Total Occupancy Load	500 persons

d.) Below-grade areas are (fully sprinklered and) separated from the Concourse by a minimum of two hour rated construction. They have alternate means of egress via several stairs and ramps exiting to the Street. Therefore, the Concourse Public Passageways can serve as an Area of Refuge (C26-603.3) permitting an exit reduction of 50%.

Summary

Total Occupant Load	- 500 persons
50% Exit reduction	- 250 "
Occupant load, for which exits must be provided	= 250 persons

NOTE #4

This stair serves as the means of egress from the proposed Alexanders Department Store Mezzanine. The stair is therefore not included in the Concourse Count. Stair terminates within the Alexanders space. Path of egress is

through the store to Liberty Street exits. Capacity of this stair limits the Mezzanine occupancy to 240 persons, unless additional exits are provided.

NOTE #5

The Hotel is separated from the World Trade Center by at least two hour rated construction. The proposed exit from the Hotel into the WTC Lobby is the Hotel's remote exit. The simultaneous occurrence of an emergency in the Concourse, the proposed Twin Theaters and the Hotel is considered improbable. Therefore, the person count from the above Hotel remote exit has not been included in the Concourse Occupant Count, although the required exit units from the Hotel into the WTC Lobby will be provided.